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United States Department of Agriculture

Forest Service

NORTHEASTERN FOREST EXPERIMENT STATION

Amherst, Mass.

ANNUAL INVESTIGATIVE PROGRAM

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NORTHEASTERN FOREST EXPERIMENT STATION
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NORTHEASTERN FOREST RESEARCH COUNCIL

Appointed by the Secretary of Agriculture to serve in an advisory capacity to the Northeastern Forest Experiment Station and to coordinate and stimulate forest research by all agencies in the Northeast.

Maine

G. T. Carlisle, Jr.	Consulting Forester.
N. L. Violette	State Forest Commissioner.

New Hampshire

W. R. Brown	President, New Hampshire Timberland Owners Association.
J. H. Foster	State Forester.
J. C. Kendall	Director, New Hampshire Experiment Station and Extension Service.
L. F. Whittemore	General Agent, Boston & Maine Railroad.

Vermont

P. H. Merrill	Commissioner of Forestry
B. S. Ward	President, Ward Lumber Company.

Massachusetts

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R. W. Thatcher	President, Massachusetts State College.
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W. L. Slate	Director, Connecticut Agricultural Experiment Station.
J. W. Toumey	Professor of Silviculture, Yale School of Forestry.

Rhode Island

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New York

H. P. Baker	Dean, New York State College of Forestry, Syracuse University.
R. S. Hosmer	Head, Dept. of Forestry, Cornell University.
W. G. Howard	Supt. Lands and Forests, Conservation Dept.

New York (Continued)

R. S. Kellogg	Secretary, News Print Service Bureau.
G. N. Ostrander	Manager, Woodlands Department, Finch, Pruyn and Company.
G. W. Sisson, Jr.	President, Racquette River Paper Company.

NORTHEASTERN FOREST EXPERIMENT STATION

Personnel

Permanent

C. Edward Behre	Director
Guy R. Stewart	Senior Forest Ecologist
M. Westveld	Silviculturist
Paul W. Stickel	Associate Silviculturist
Lester H. Reineke	Associate Silviculturist
Victor S. Jensen	Assistant Silviculturist
Harold F. Morey	Junior Forester
Richard H. Blythe, jr.	Junior Forester
Perley Spaulding (Bureau of Plant Industry)	Senior Pathologist
H. J. MacAloney (Bureau of Entomology)	Assistant Entomologist
J. Paul Miller (Bureau of Biological Survey)	Junior Biologist
Mary E. Turrell	Senior Clerk
Esther E. Scott	Assistant Clerk
Catherine A. Heaphy (In cooperation with Division of State Cooperation)	Assistant Clerk
Mary C. Weldon	Junior Clerk
Dorothy E. Thier	Assistant Computing Aid

Temporary

Lowell Besley	R. P. Holdsworth, jr.
Harold Eno	J. W. Johnston, jr.
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John E. Hetzel	Edward Williams
Kenneth Hinkley	R. E. Wilson, jr.
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Collaborators

M. F. Morgan) : H. J. Lunt)	Connecticut Agricultural Experiment Station
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HIGHLIGHTS OF STATION WORK DURING 1931

1. Compiled from best available sources statistics on forest areas, quantity and character of standing timber, and present and prospective annual growth for the states of Maine, New Hampshire, Vermont, and Massachusetts. This was done as part of a nation-wide project by the U. S. Forest Service to supply data for the President's Timber Conservation Board.

2. Conducted intensive survey of the Gale River and Bartlett Experimental Forests. These surveys are essential to the efficient management of the experimental forests and will provide valuable data on the growth of the various stands in future years. A good start was also made on the construction of roads to make all parts of the experimental forests accessible.

3. Constructed new volume tables giving merchantable content of principal species of northern hardwoods. These tables were needed for immediate use of the White Mountain National Forest as older tables had proven unreliable. The new tables eliminate artificial assumptions as to top diameter utilization.

4. Initiated comprehensive study of forest planting in the Northeast. An extensive survey of existing plantations is well under way. Plans for experimental plantings of selected stock of known origin and for studies of planting methods have been mapped out.

5. Initiated intensive study of heart rots in balsam fir. Detailed knowledge of the character and prevalence of heart rots as well as age at which timber is affected under varying growth conditions is essential for the effective management of pulpwood stands containing balsam fir timber.

6. Prepared preliminary rules for estimating cull in standing northern hardwood timber. Defect in northern hardwoods is not only of general occurrence, but is an important and variable factor in timber estimating. These rules are an attempt to correlate the amount of cull with the external appearance of the trees.

7. Accumulated additional evidence on the stimulation of growth of pulpwood species by the girdling of defective and worthless hardwoods in northern New England and assisted in the application of the principles of selective girdling to a property of 5000 acres in Vermont.

8. Found Riga variety of Scotch pine to be extremely resistant to attacks of the white pine weevil.

9. Completed report on "The Measurement and Interpretation of Forest Fire-Weather in the Western Adirondacks" which was published by the New York State College of Forestry. Prepared charts for estimation of forest fuel moisture content from relative humidity, temperature, and number of hours since last rain for conditions of the white pine type at Petersham, Mass. These charts will assist fire wardens in translating weather forecasts into actual burning conditions.

10. Completed a report on Forest Fires in Vermont for the period 1911 to 1925. This report analyzes factors affecting the forest fire record and offers suggestions for strengthening the protective effort and dealing with principal causes of fires.

Northeastern Forest Experiment Station

Annual Report and Investigative Program 1932

History

The Northeastern Forest Experiment Station is one of eleven regional experiment stations maintained by the Forest Service, United States Department of Agriculture, to cover all of the principal forest regions of the country. The territory served by the Northeastern station includes all of New England and New York.

The forest experiment stations fulfill the same functions in regard to the development of forest resources and forest industries that the agricultural experiment stations do for agriculture. Altho most of the forest experiment stations have been in existence for several years, a comprehensive program of federal forest research was first authorized in 1928 under the McSweeney-McNary Forest Research Act.

This act outlined the regional set-up of the experiment stations and provided for specific appropriations to cover not only research dealing with the production and protection of forest crops, but also for work in forest pathology, forest entomology, forest biology, forest fire-weather forecasting, range investigations, forest products, forest economics, and a comprehensive survey of forest resources of the nation.

Within the past two years, as a result of a growing realization of the importance of forests in relation to water resources, it has been proposed to add another section to the McSweeney-McNary Forest Research Act to provide for an adequate program of investigations on the influence of forests upon streamflow erosion and water supply.

The Northeastern Forest Experiment Station was established in 1923 with an initial appropriation of $25,000. In 1925 a pathologist from the Bureau of Plant Industry was assigned to this station, and the following year the Bureau of Entomology also assigned a man to the Northeast. In 1930 the force was again expanded by the assignment of a specialist in food habits of birds and rodents from the Bureau of Biological Survey. Except for slight internal adjustments, no change in the initial appropriation for silvical studies accompanied this expansion in the work of allied bureaus until 1931. In that year, however, additional funds were provided for initiating two new major lines of work in forest management, and the work in forest pathology was somewhat expanded. The total Forest Service appropriation for the present fiscal year is $46,500 in addition to funds contributed by the cooperating bureaus. This will be reduced somewhat for the fiscal year commencing July 1, 1932, in line with general economy measures.

Outlook

Altho these developments have greatly increased the usefulness of the station, there are still several important fields which are inadequately covered or not handled at all, so that continued effort will be necessary to expand the work to meet the needs of the region. Up to the present it has been necessary to concentrate studies

in forest management largely on the spruce forests of northern New England and New York. The new work on forest planting will extend throughout the region, but aside from this no comprehensive studies in the management of white pine or the oak forests of southern New England and New York will yet be possible.

The station's program of forest fire research has also been confined chiefly to the northern part of the region. Because of local climatic conditions, however, the principal zone of fire hazard is in the southern portion of the region. For this reason it would be extremely desirable to extend the fire-weather studies which the station has undertaken in cooperation with various agencies, to the oak forests of Connecticut, the pitch pine type of Cape Cod, and the special conditions of Long Island. Nothing has yet been done on the important problem of the damage done by forest fires. Without intensive studies in this field it is difficult to create in the mind of the public a full realization of the necessity of preventing forest fires and all estimates of fire damage are made in the most haphazard fashion. This may be considered one of the urgent needs of the region at present.

Perhaps the most important line of work demanding attention is that of forest economics. For all the forest types of the region existing technical knowledge is far ahead of the practice of forestry in the woods. The difficulties are largely economic in character. There is practically no authentic statistical information on the amount, quality, or location of timber of various sorts and equally scanty knowledge of regional growth either present or potential. Depletion of the northeastern forests has gone so far that many wood-using industries have moved to other regions. The second growth over much of the region, is of such low quality, woodland ownership is in general so scattered, and manufacture by portable mills so inefficient, that satisfactory markets are hard to find. Local tax situations encourage the liquidation of timber as soon as it reaches merchantable size and discourages the practice of cultural measures to improve the quality of young timber. As a result of all this, there is no public appreciation of the economic value of forest management to the region.

Economic research along three lines should be undertaken as soon as possible to meet this situation. The first of these is a comprehensive survey of forest resources, including not only an estimate of the quantity and location of existing supplies, but also studies of present and potential growth for the region, estimates of rate of depletion, present rate of consumption, and trends in the utilization of forest products.

The second project would have as its objective stabilization of the forest industries in the region. It would involve a complete analysis of the principal industries, covering such topics as organization, financial structure, production and manufacturing methods and technique, marketing, merchandising, and possibilities of cooperation within the industries. This project would approach the question of costs and returns in forestry from the standpoint of studying costs in manufacture and distribution in order to determine the margin left as return for the growing of the timber. It would provide a basis for determining under what conditions and upon what lands the growing of timber should be profitable.

Keen interest in a project of this sort has already been indicated by responsible agencies in the region and a definite plan of work awaits the appearance of adequate financing for initiation of the study. Since the results of work of this sort are fundamental to any progress in the solution of the economic problems of the region, and since funds for the work have not yet been provided elsewhere, it is highly desirable that the federal government assume the leadership in financing the project on a cooperative basis. This may be effectively done by providing an appropriation under Section 10 of the McSweeney-McNary Act. This project would be of national interest because it deals with the results of continued unregulated exploitation of forest resources in a region from which the virgin timber has long been exhausted. It should provide a background which will enable other regions with shorter history to develop a more satisfactory and efficient husbandry of their resources.

A third important line of economic study which is closely related to those already outlined would aim to show how forest management would contribute to community prosperity in rural districts of the northeast and what the possibilities are of more effectively integrating agriculture and forestry. It would analyze the costs and returns in forestry operations from the standpoint of the landowner and lay the groundwork for more widespread practice of forestry on private lands. This work ties in closely with land utilization studies in progress at some of the state agricultural experiment stations now.

Forest Research Council

Since the last annual report the membership of the Northeastern Forest Research Council has been strengthened by the addition of several new men. The Council has continued to function in an effective and constructive manner.

As a result of the recommendation of the Northeastern Forest Research Council a conference of men engaged in forest planting research was held in Boston, April 1931. This conference was attended by 23 men representing 9 agencies besides the U. S. Department of Agriculture. The conference outlined a plan for the planting studies of the Northeastern Forest Experiment Station, made several suggestions of special problems needing intensive study, and considered coordination of planting investigations among the various agencies of the region. Maintenance of a current list of projects under way by all agencies and compilation of standards for field measurements and publication in connection with planting studies were recommended.

The Research Council held its summer meeting at Newcomb, N. Y., in September, 1931. Mr. Ripley Bowman, Secretary to the President's Timber Conservation Board, was a guest of the Council at this meeting. Mr. Bowman outlined the work of the Timber Conservation Board and referred to the extensive revision of the Capper Report in order to supply better statistics on the status of the country's forest resources as one of the most important projects of the board. The work on this statistical report was handled by the Forest Service and Director Behre explained how the task had been organized in the Northeast. He explained the difficulties involved in avoiding discrepancies between states and gave some preliminary comparisons of figures on forest areas and stands of sawtimber with those published for New England in the Capper Report of 1920.

The Council also had Mr. Joseph Kircher, Regional Forester, Eastern District, Washington, D. C., as its guest. Mr. Kircher told the Council of the acquisition and management of the eastern national forests and showed how the work of the experiment stations was needed for and related to the development of the national forests.

At this meeting the Council inspected the experimental areas which were established the previous year as a cooperative endeavor by Finch, Pruyn and Company, the Forestry Department of Cornell University, and the Northeastern Forest Experiment Station. The cuttings on these areas were planned to establish the possibilities of reducing the period between successive jobs on the same area so that the growth of merchantable balsam pulpwood which is destroyed by rots and windthrow if allowed to stand too long, might be utilized.

In addition to visits to the experimental areas, as guests of Finch, Pruyn and Company, visits were made to other portions of the company's pulpwood operations. The field trips were held in conjunction with the Empire State Forest Products Association.

The sixteenth meeting of the Research Council took place in Boston, Mass., on February 2, 1932. This meeting was attended by fourteen members of the Forest Service and a group of entomologists from other agencies in the region. The morning session was held in conjunction with the New England Section, Society of American Foresters.

Primary attention was given to consideration of the European Pine Shoot Moth situation which is assuming alarming proportions in the southern portions of the region. Studies of life history and control of this insect are in progress at the Connecticut Agricultural Experiment Station and the New York State College of Forestry while some work with parasites has been undertaken at the Gypsy Moth Laboratory of the U. S. Department of Agriculture. Pending the development of an effective and cheap control the immediate need is for definite knowledge of the dispersion of the insect and arrangements for cooperation by all states and other agencies in destruction of severely infested plantations, scouting for new infestations and undertaking control measures. A committee of the Council was appointed to stimulate suitable action in this matter. The discussion also led to a general resolution which would place protection of the forests from insects and disease on the same basis as protection from fire, by making state and federal funds currently available for eradicating outbreaks in their initial stages.

The need for further studies of the relation of forests to water resources was another topic considered at this meeting. Behre outlined the widespread importance of water resource problems, and explained the proposed amendment to the McSweeney-McNary forest research act to set up a program for studies in this field. This program is of especial interest to the Northeast from the standpoint of conservation of water supplies for areas of dense population. The Council endorsed the program for research in this field as proposed in the Leavitt Amendment.

The third subject discussed at the Boston meeting was the place of Forest Research in Reorganization of Federal Bureaus. This subject was presented by R. E. Marsh, U. S. Forest Service, Washington, D. C., who stated that he felt the research work should remain with the Forest Service and pointed out many reasons why this work

was more closely allied to the Department of Agriculture than other departments. In the discussion of this subject it was emphasized that foresters should recognize changing economic conditions and changing attitudes of the people toward government and be ready to lead in framing policies to meet new conditions.

Experimental Forests

During the spring of 1931 construction of roads to make all sections of the two experimental forests in the White Mountains accessible for the extraction of products from experimental cuttings was commenced with money provided under the emergency unemployment relief appropriation. Because of the high cost of construction on these areas it will be several years before this road building program can be completed unless special appropriations become available again.

The ranger station on the Bartlett Experimental Forest has been turned over to the experiment station and living conditions at the Gale River Field Quarters have been improved by the installation of a water system which taps the supply of the town of Littleton. Plans have been drawn up for the development of more adequate field stations on both forests.

During the past season substantial progress was made on intensive invent ories of both the Gale River and Bartlett Experimental Forests. These inventories will be completed during the summer of 1932 and will provide a wealth of data for future management of the forests. Meteorological instruments have also been installed at each forest headquarters so that yearlong observations of environmental factors can be obtained. These records are being supplemented by observations during the growing season at certain points in the forests where experimental work is in progress.

Initial cuttings were made on the Gale River Experimental Forest during the fall of 1931. This involved the removal of 50 cords of balsam from a stand of about 55 years of age, leaving a good substantial stand of red spruce for future growth. Several cords of hardwood were also cut from wolf trees scattered through this area. The usual sale of fuelwood from the Bartlett area was on a much smaller scale this year, only about 100 cords having been sold. In the cutting of this wood former cutting areas were blocked out and decadent wolf trees were removed.

A resident superintendent has been employed for the experimental forests in the White Mountains. He will divide his time between the Gale River and the Bartlett areas, making permanent headquarters at Bartlett. Richard H. Blythe was appointed from the Junior Forester list for this assignment.

Preliminary consideration has been given to the location of an experimental forest in the Green Mountain Purchase Unit. A tract containing a considerable amount of open abandoned farm land interspersed with woodlots cut over at various periods in the past would provide the station with an area typical of much of the northeastern region. Such an area would afford an opportunity for working directly on problems concerned with the rehabilitation of the forests in sections formerly developed for agriculture and would be of especial value for experimental planting work. None of the other experimental forests present conditions of this sort.

During the past year Finch, Pruyn and Company, paper manufacturers of Glens Falls, N. Y., have offered to devote a square mile of their lands to experimental use by the Northeastern Forest Experiment Station in cooperation with the Forestry Department of Cornell University. The tract involved is admirably situated near Newcomb, N. Y., on one of the main highways through the Adirondack Mountains. It contains a good representation of the typical forest types of northern New York. The Cornell Forestry Department has used a portion of this tract for its summer camp for a number of years and the experiment station already has some cooperative work in progress in the vicinity. Negotiations in regard to the use of this tract are under way and a final decision should be reached in the spring of 1932.

The Massachusetts State College has completed an intensive inventory of the Mount Toby Demonstration Forest. This was accomplished with the advice and collaboration of the experiment station. The Mount Toby Forest has continued to be used for work of the station in a definite way. The station biologist has made especially intensive use of this area during the past in connection with his studies of the fauna of white pine stands.

Natural Areas

An area of 510 acres, constituting the western half of what is known as "The Bowl," which is a deep valley on the east side of Mount Whiteface, N. H., has been designated a Natural Area in the White Mountain National Forest. This tract is one of the few readily accessible areas which still contain virgin forests representing all the principal timber types of the spruce region including spruce and hardwood mixtures.

Since no federal lands are located in other forest regions of the Northeast, there are no prospects for other natural areas under consideration at present.

Administrative Research

Close cooperation has been maintained between the White Mountain National Forest and the Northeastern Forest Experiment Station during the past year. The National Forest assigned a ranger to the experiment station for a total of two weeks' time to assist in the detailed survey of recent fuelwood cuttings on the Bartlett Experimental Forest. The National Forest has actively prosecuted its studies of conditions on cut-over areas and has completed reports on several tracts.

But the staff of the White Mountain Forest has been much more active in studies of administrative problems than in silvical work, and rightly so. This started with thorough-going ranger district analyses in 1929, as a result of which the entire organization of the forest was remodeled. Subsequently detailed studies of the supervisory job of the forest and of the clerical job load have been made, and a new cost accounting system has been absorbed. Analysis of administrative problems such as those outlined is an important task of no small size. One of the major opportunities of the national forest enterprise is to demonstrate effective management of forest properties. Studies aimed to develop the most efficient organization and administrative practices lead to progress in this respect. Yet to do this thoroughly is more than any organization should be expected to handle without special assistance. Perhaps this is another field in which the Branch of Research may fill a definite need.

Cooperation

In order to meet the immediate need of the White Mountain National Forest for revised volume tables for northern hardwoods special emphasis was laid on this subject as the initial phase of the new hardwood growth project started by the Experiment Station during the past summer. Tables of merchantable contents of the principal species were prepared by a special technique and are apparently proving satisfactory in use. Supplementary tables for small sized trees and for total content of the larger trees will be developed during the coming season.

A conference between members of the experiment station and the staff of the White Mountain Forest was held during November 1931 for the purpose of revising the terms of the cooperative agreement concerning the operation of experimental forests in the White Mountains. A number of uncertain points were cleared up and arrangements were made for the resident superintendent of the experimental forests to spend some time with the district ranger and in the supervisor's office in order to become thoroughly familiar with administrative practices on the forest.

The White Mountain National Forest not only undertook the construction of roads on the experimental forest, but has agreed to handle the major annual maintenance work on these roads. This can, of course, be done most effectively as part of the regular maintenance program of the forest.

Cooperation with the Massachusetts State College in the development and use of the Mount Toby Demonstration Forest has already been mentioned. Stickel repeated his course in Forest Ecology for graduate students at the college during the winter term of 1932. Westveld has given a special lecture to one of the forestry classes at the college, and Behre addressed the College Research Club on "The Organization of Research at the Forest Experiment Stations."

To provide office space for the enlarged staff of the experiment station the College has turned over another classroom in French Hall. However, since the space now occupied by the experiment station will be needed by the College next fall to meet the demands of a rapidly increasing enrollment, it will be necessary for the experiment station to locate elsewhere during 1932.

Cooperation of the New York State College of Forestry in the fire-weather project was completed by the publication and distribution of the report as a bulletin of the College.

The Bureau of Plant Industry, the Bureau of Entomology, the Biological Survey, and the Weather Bureau have continued their cooperative work in the Northeast as part of the McSweeney-McNary forest research program. That there is a need for this cooperative work on a larger scale, especially with reference to the protection of forests from insects and disease is evidenced by a resolution adopted by the New England Section, Society of American Foresters, in February 1932 as a result of a committee report urging expansion of this work.

Cooperation with Finch, Pruyn & Co. and the Cornell Department of Forestry in the experimental pulp cuttings near Newcomb, New York, was continued during 1931. The company completed the removal of the marked timber and students at the Cornell Camp assisted in retally of the plots to establish losses to reproduction and young growth through logging.

Status of Investigations

Forestation:

A comprehensive study of forest planting in the Northeast was initiated in the summer of 1931 with the appointment of Dr. G. R. Stewart to handle the work. Following the recommendations of the special conference on forest planting research sponsored by the Northeastern Forest Research Council, field work thus far has been confined to a survey of existing plantations in the region. Following a general reconnaissance of conditions throughout the region the intensive examinations were concentrated on the older and more significant plantations in portions of New York, Vermont, Massachusetts, and Rhode Island. In New York, working with a representative of the State Conservation Department, an attempt was made to check up on all plantations made with stock from the state nurseries in a group of counties. In western Massachusetts especial attention was given to plantations on municipal watersheds and all significant plantings on Cape Cod were visited. It is apparent from the work of the past season that it will be impossible to secure reliable information on origin of stock, method of planting, and early treatment except in a few cases.

Detailed soil analyses of certain white pine plantations at Norwich, N. Y., in which trees had begun to die after having been used regularly as roosting grounds for a large flock of blackbirds showed that the injury was due to the effect of an excess of nitrogen in the upper layers of the soil caused by the large quantities of bird droppings.

The survey of existing plantations will be continued during the 1932 field season after which a report on conditions found will be prepared. During the spring of 1932 studies will be made of planting technique and costs in the various states. A third activity planned for the coming spring is the experimental planting on a number of selected sites in various parts of the region of stock of Scotch pine grown from seed collected from trees of a particularly promising strain reproduced naturally near Booneville, N. Y. This cooperative endeavor will be made possible through the courtesy of the New York State Conservation Commission, which will supply the planting stock.

Management:

Work on studies of the management of spruce was concentrated during the past year largely on remeasurement of experimental plots at various places and in organizing the Gale River Experimental Forest as a research laboratory for the production of spruce.

Some idea of the speed of response to girdling operations is brought out in the growth rate of spruce on girdled and ungirdled plots established in 1929 near Waterville, New Hampshire. The plot on which selective girdling of hardwoods was practiced in 1929 contained at that time 425.3 cubic feet of spruce and fir per acre. Two years later this plot contained 510.6 cubic feet, an increase of 85.3 cubic feet. The increase during the same period on the check plot amounted to 54.6 cubic feet, the original 658.4 cubic feet having increased to 702.6. The average annual increase on the check plot was only 64 per cent as much as occurred on the girdled plot.

With the general principles of selective girdling established from previous work, Westveld has devoted some time to working out the detailed application of these principles on the property of E. S. Bryant, near Bolton, Vermont. The treatment of this property consists of selecting merchantable spruce which was being retarded by hardwoods and girdling these hardwoods by single frilling. On a sample acre measured to study the results of this treatment, 36 spruce trees ranging from 6 to 16 inches were designated as requiring release. Twenty-six hardwoods of which 19 were yellow birch, 5 beech, and 2 sugar maple, were girdled in the process of releasing the 36 spruces. Detailed descriptions for each of the 36 spruces were obtained on the following points: d.b.h., total height, height to base of crown, clear length, condition of bole, vigor. Data were also obtained on the width and length of crown and crown density. Of the 68 additional spruce and fir ranging from 3 to 18 inches that occur on the plot, undoubtedly the majority will receive some incidental benefit from the girdling of the hardwoods.

The property on which this work was done contains about 5000 acres. It is only by following the results of experimental research through to their commercial application in this way that the work of the experiment station can be made of real value to the region.

Pathology:

In connection with the survey of the experimental forests in the White Mountains, some preliminary work was done on the heart rots of northern hardwoods and this led to the formulation of a set of suggestions for estimating cull in these species. It was found that four fungi were responsible for most of the defect. The distribution of these fungi on the various hardwood species was noted and the character and extent of the rot studied by sectioning selected trees. The suggestions for estimating cull were embodied in Technical Note #10 and distributed throughout the region.

Detailed studies of the heart rots of balsam were also commenced during the summer of 1931. This project has for its object the determination of the progress of decay in standing pulpwood timber as the basis for management to utilize all the balsam fir which the land produces and to avoid the usual waste from windfall and decay. All balsam trees on five quarter-acre sample plots on the Gale River Experimental Forest were cut and analyzed for the presence of decay. These plots were all about 60 to 70 years of age. Additional observations were obtained from an older stand at Cherry Mountain, N. H.

Three fungi were found to cause most of the cull in balsam. Two of these are butt rots and the third is the "red heart" which affects the middle and upper portions of the trunk. The butt rots are especially serious because of their weakening action which leads to breakage by wind. On the areas studied on the Gale River Experimental Forest butt rots were found in 42% of the merchantable trees and were responsible for a cull of 4.5% of the merchantable volume. Windfall has not yet become a serious factor in these areas. Red heart attacked 7% of the trees and caused a cull of 3% of merchantable timber. Injury by carpenter ants was also found in 3% of the merchantable trees. Decay was found to be correlated with age but not with diameter or vigor of the trees. No decay was found on trees less than 40 years of age.

This work will be extended to cover stands of other ages and under other conditions during 1932. The results of the past season's work have been summarized and distributed as Technical Note #11.

Mensuration:

Appropriations became available in 1931 to undertake studies of growth and yield of the northern hardwoods. This project will supplement nicely the studies on growth and management of spruce and fir, species which are often associated with the northern hardwoods. The Bartlett Experimental Forest which is being developed as a research laboratory for the management of northern hardwoods will afford much material for this project. During the past summer basic data on the distribution of trees of various sizes and species in stands of many kinds were accumulated in the course of an intensive survey of the Bartlett Experimental Forest. Records which extend back over a period of 25 years on a number of permanent sample plots in northern hardwood stands in Vermont are also available and are being analyzed this year.

The first definite accomplishment in this project was the preparation of new tables of merchantable volume for the northern hardwood species. Existing tables were proving unsatisfactory for the purposes of the management inventory now under way on the White Mountain National Forest so that an especial effort was made to provide suitable tables for immediate use. In order to avoid the difficulties which arise as a result of standardization of top diameter limits in the construction of volume tables a new and simple technique was used. A chart for the estimation of scaling diameter at any point on the merchantable portion of the stem was constructed by multiple correlation of the scaling diameter with diameter breast high and height above ground. The scaling diameters read from this chart were then used to build up volume tables for trees of various diameters and merchantable height classes. Tables constructed in this way conform closely to nature and should prove quite accurate.

Tables have been prepared for beech, sugar maple, yellow and paper birch and white ash. It appears that the various species are not essentially different in certain characteristics affecting volume and study will be given to the possibility of measuring several species with a single set of basic tables.

Field work has been in progress during the winter to accumulate supplementary data to make possible the construction of tables showing total cubic content of trees of all sizes including unmerchantable saplings. L. H. Reineke has been transferred from the California Forest Experiment Station to take charge of this project, and H. F. Morey has been transferred from the Allegheny Forest Experiment Station to assist in the work.

Analysis of the figures from the remeasurement of a number of red spruce trees which had been released by selective logging in 1925 showed that there had been no significant change in form on the average. The range of form quotients of the individual trees, however, had become much less in the five year period since logging. Trees which were of relatively low form quotient at the time of release showed an increase in form quotient and those with high form quotients declined toward a common mean. This result confirms the indications obtained from increment borings on the same trees which showed the effect of an earlier cutting, and are in harmony with a similar study on ponderosa pine in Oregon.

Protection:

A report on "The Measurement and Interpretation of Forest Fire-Weather in the Western Adirondacks" by P. W. Stickel of the Northeastern Forest Experiment Station was published by the New York State College of Forestry early in 1932. It embodies the results of five years' cooperative observations at Cranberry Lake, N. Y. In this report zones of fire hazard depending on moisture content of the duff in the spruce-hardwood type are defined. The effect of various meteorological factors upon the duff moisture content is analyzed in detail and charts are given to enable members of the protective organization to estimate duff moisture content from current observations of evaporation, air temperature, and hours since last rain. Comparison of burning conditions in the uncut forest with those in openings emphasize the fact that the forest itself affords a most effective measure of protection.

Analysis of similar data from a station in the white pine type at Petersham, Mass., shows that although evaporation is the best single index of duff moisture content here as at Cranberry Lake, yet the hygrometric factors assume greater significance and charts for estimating the duff moisture content will be based on relative humidity, air temperature, and hours since rain. The report on the work at Petersham should be ready during 1932.

In the spring of 1931 a number of tests were made to determine the value of calcium chloride as an aid in fire control. Test fires on grassland were allowed to burn up to lines treated in various ways with dry calcium chloride. When fires burned up to a line which had been treated with the chloride on the previous day they either went out or were easily subdued, but under other conditions the chloride was of little value. The chief difficulties are that the chemical deliquesces too slowly when applied during the day, and that the flakes fall through the inflammable mat so that fire may run through the weeds even though the surface of the ground itself may be quite damp. The effect of the chloride is removed by rain.

The report on statistics of Forest Fires in Vermont for the period 1911 to 1925 was completed during the year. Vermont is a state of relatively low fire danger, and the record compares favorably with other states. Yet there is room for improvement and careful study is especially important because it is difficult to maintain an efficient organization when severe tests come at infrequent intervals. The situation calls for strong and active supervision of forest fire protection plans and activities in each town and county and especial emphasis on fire prevention.

The fire danger varies considerably in different parts of the state, being less severe in the northern counties and in the mountains than in the southern counties and lower elevations. The spring fire season is about three weeks later in Essex County in the north than in Windham County in the south.

Brush burning, railroads, and smoking are found to be the principal causes of fires and all of these are subject to control. The importance of preventing fires attaining large size is repeatedly brought out. This means prompt and effective attack and continuing work on going fires throughout the night.

Entomology and Biology:

Work of the station entomologist has continued to be directed largely toward studies of the white pine weevil. Experiments in trapping the weevil were entirely unsuccessful as no bait could be found which would attract the insect. Observations of the effect of winter conditions on weevil population have been continued. It has been found that Scotch pine of the so-called "Riga" variety is particularly resistant to attacks by the white pine weevil. Plantations of this variety of Scotch pine in localities where weevil damage is abundant have been only slightly affected, although the tips have been severely attacked. The trees in the resistant plantations are of unusual vigor and are apparently able to drown out the young larvae of the weevil by an abundant flow of pitch. Studies of the relation of birds and mammals to the white pine weevil have not led to encouragement that control might be feasible from this angle. The work will be continued through 1932.

The station entomologist has cooperated with Assistant State Forester Galarneau in working out the application of the principles of treating severely weeviled white pine plantations on the property of Mr. Marshall Crane at Dalton, Mass. A graduate forester working under the direction of Mr. Galarneau and Dr. MacAloney was employed by Mr. Crane to supervise the treatment of a 38 acre plantation about 20 years old. The treatment involved selective girdling to favor the straightest trees, usually in the codominant or intermediate crown classes, and pruning of the favored trees. The total cost of this job averaged $8.65 per acre and should bring through a satisfactory crop of about 200 trees per acre. Without such treatment it is doubtful whether severely weeviled plantations of this sort would ever have any commercial value.

This work illustrated again, just as mentioned above in regard to the stimulation of growth of pulpwood species, a follow up of experimental results by application in commercial practice which should lead to more widespread use and benefit from the research work.

Project Summary

As part of changes in cost accounting affecting all the experiment stations the scope and designation of projects have been modified during the past year. The changes are made in the interest of simplification and do not apply to work of the other bureaus cooperating with the Forest Service. There are 23 active projects on the program for the coming year of which only 7 are listed as major projects. The balance are projects requiring only incidental attention or current work to maintain long time records on permanent sample plots.

MAJOR PROJECTS

Forestation:

Forest Planting (F-1) Stewart

Management:

Management of spruce-hardwoods (M-1, formerly Mc-1 and Mb-1) Westveld

Mensuration:	
Growth Yield of northern Hardwoods (ME-3)	Reineke
Protection:	
Fire Behavior (Pf-2 - formerly Pf, B-5 and Pf, C-7)	Stickel
Rots in Balsam Fir (Pd-7)	Spaulding
Control of White Pine Weevil (Pi-4)	MacAloney
Relationship of Birds and Mammals to the White Pine Weevil and White Pine Blister Rust	Miller

MINOR PROJECTS

Botany:	
Phenological Observations of Forest Vegetation (Bp)	Stickel, Morey
Management:	
Management of Central Hardwoods (M-2)	Westveld, Jensen
Management of Northern Pines and Hemlock (M-3)	Behre, Stickel, Jensen
Development of Private Forestry (RE, formerly M-1-WO)	Staff
Mensuration:	
Development of Universal Taper Volume Tables (ME-1)	Behre
Growth and Yield of Spruce and Balsam Fir (ME-2)	Reineke
Converting Factors (RE, Survey 1; formerly ME-2-WO)	Staff
Regional Yields (RE-Survey-2, formerly ME-1-WO)	Staff
Manual of Field Methods (ME-4-WO)	Staff
Protection:	
Fire Attack (Pf-1, formerly Pf, d-2)	Stickel
Chestnut Blight (Pd-1)	Spaulding
White Pine Blister Rust (Pd-2)	Spaulding
Shade and Ornamental Tree Diseases (Pd-5)	Spaulding
Miscellaneous Forest Tree Diseases (Pd-6)	Spaulding
Heart Rots of Northern Hardwoods (Pd-8)	Spaulding
Miscellaneous Forest and Shade Tree Insects (Pi-7)	MacAloney

Publications:

During the past year the following publications have appeared from the experiment station.

Behre, C. E., 1932. Some Aspects of the Forest Planting Situation in the Northeast. Jour. For. XXX:162-168.

Cline, A. C. and MacAloney, H. J. 1931. A Method for Reclaiming Severely Weeviled White Pine Plantations. Mass. Forestry Association Bul. 152. 12 pp., 2 illus.

Dana, S. T. 1931. Forest Fires in Maine 1916-1925. Maine Forest Service, Bul. 6, 73 pp., 33 figs.

Spaulding, P., and Hansbrough, J. R. 1932. The Sweet Fern Pitch Pine Blister Rust, Cronartium Comptoniae. U.S.D.A. Circular 217.

Spaulding, P. and MacAloney, H. J. 1931. A Study of Organic Factors Concerned in the Decadence of Birch on Cut-Over Lands in Northern New England. Jour. For. XXIX:1134-1149 (also Technical Note 9).

Spaulding, P., Hepting, G. H., and Westveld, M. 1931. Suggestions for Estimating Cull in Northern Hardwoods. Technical Note 10. 3 pp.

Spaulding, P., Hepting, G. H., and MacAloney, H. J. 1932. Investigations in Decays of Balsam Fir. I. Gale River Experimental Forest, New Hampshire. Technical Note 11, 2 pp.

Stickel, P. W. 1931. Forest Fire Research, Empire Forester, XVII:7-16. 1 fig.

Stickel, P. W. 1931. The Measurement and Interpretation of Forest Fire-Weather in the Western Adirondacks. New York State College of Forestry, Technical Bulletin 34, 115 pp., 10 pl., 26 fig.

Westveld, M. 1931. Releasing Merchantable Sized Spruce and Fir Through Girdling. Technical Note 8.